US008223029B2

(12) **United States Patent**
Chung et al.

(10) **Patent No.: US 8,223,029 B2**
(45) **Date of Patent: Jul. 17, 2012**

(54) **METHOD FOR CONTROLLING CLEANING DEVICE**

(75) Inventors: **Yu-Liang Chung**, Taipei (TW); **Chun-Hsien Liu**, Taipei (TW); **Chun-Chieh Wang**, Taipei County (TW); **Long-Der Chen**, Hsinchu (TW); **Chen Meng-Chun**, Tainan County (TW); **Chun-Sheng Wang**, Nantou County (TW)

(73) Assignee: **Industrial Technology Research Institute**, Hsinchu (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 367 days.

(21) Appl. No.: **12/649,152**

(22) Filed: **Dec. 29, 2009**

(65) **Prior Publication Data**

US 2011/0115638 A1 May 19, 2011

(30) **Foreign Application Priority Data**

Nov. 16, 2009 (TW) .... 98138838 A

(51) **Int. Cl.**
G08B 21/00 (2006.01)
G08B 23/00 (2006.01)

(52) **U.S. Cl.** **340/635**; 340/636.11; 340/693.6

(58) **Field of Classification Search** .... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,399,585 A * 8/1983 Kullik et al. 15/319
4,680,827 A * 7/1987 Hummel 15/319
5,152,028 A * 10/1992 Hirano 15/319
5,163,202 A * 11/1992 Kawakami et al. 15/319
5,182,833 A * 2/1993 Yamaguchi et al. 15/319
5,427,596 A * 6/1995 Jorgenson et al. 96/399
5,542,146 A * 8/1996 Hoekstra et al. 15/319
5,874,683 A * 2/1999 Lee et al. 73/865.9
5,918,344 A * 7/1999 Crevling et al. 15/339
6,313,597 B1 * 11/2001 Elliott et al. 318/701
7,599,758 B2 * 10/2009 Reindle et al. 700/258
2002/0075615 A1 * 6/2002 Miermans 361/78
2005/0160556 A1 * 7/2005 Hitzelberger et al. 15/389
2007/0221198 A1 * 9/2007 Yi .... 126/299 R
2008/0034532 A1 * 2/2008 Yang 15/319
2009/0119867 A1 * 5/2009 Senoo et al. 15/319

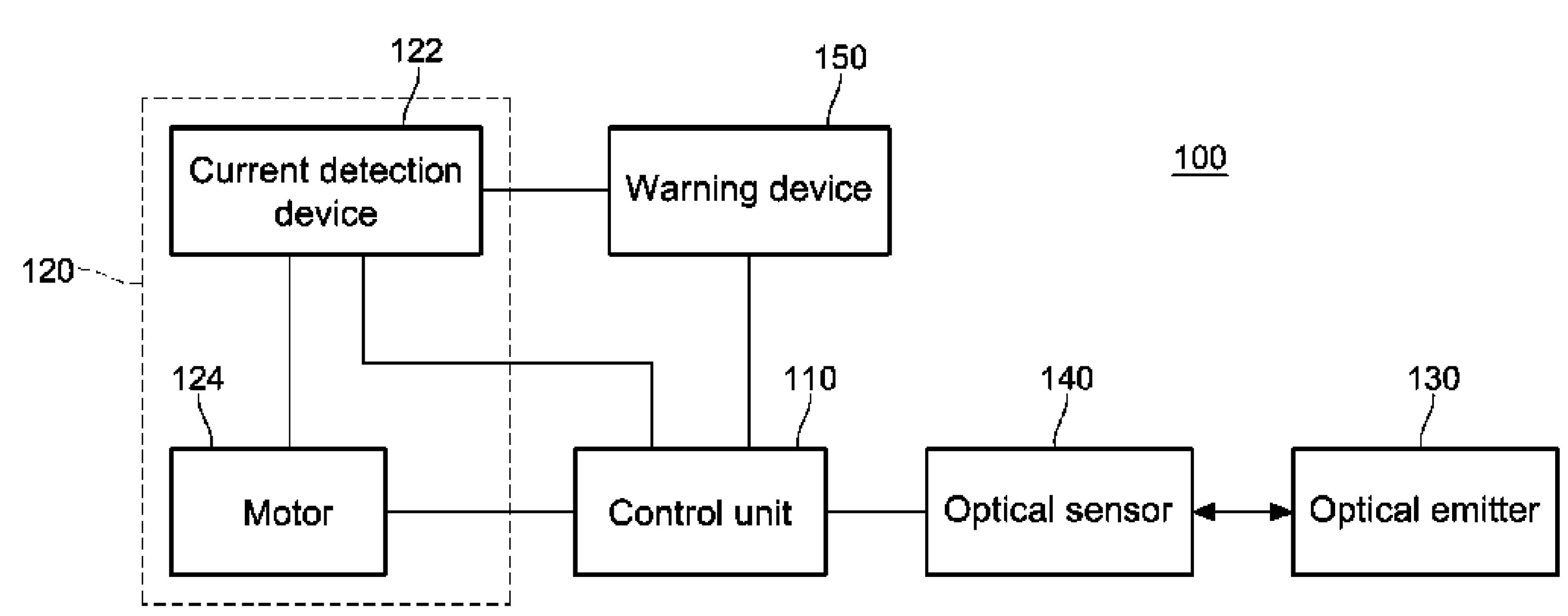
* cited by examiner

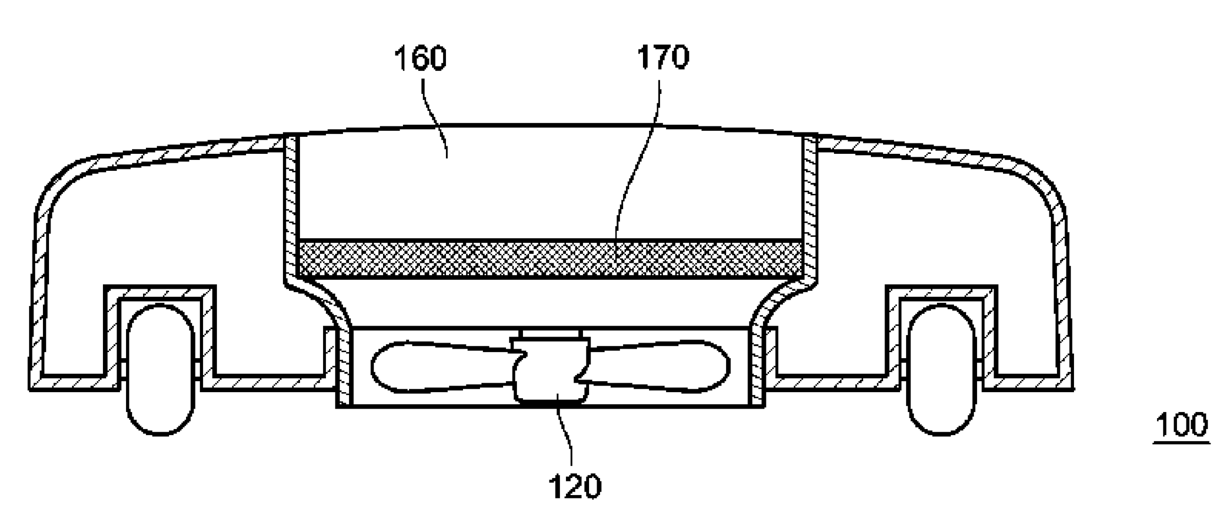
Primary Examiner — Daniel Wu
Assistant Examiner — Emily C Terrell
(74) *Attorney, Agent, or Firm* — Morris Manning & Martin LLP; Tim Tingkang Xia, Esq.

(57) **ABSTRACT**

A method for controlling a cleaning device is presented, which includes the following steps. A cleaning device includes a control unit, a fan module, an optical emitter, and an optical sensor. The optical emitter and the optical sensor are located in an air inlet of the fan module. The control unit is preset with a first impedance value (Z1), a second impedance value (Z2), and a threshold, where 0<Z1<Z2. Then, the control unit reads an impedance value (Z) of the fan module. If Z1<Z<Z2, the control unit drives the fan module. If Z2<Z, the control unit reads a detected value of the optical sensor. If the detected value exceeds the threshold, the control unit drives the fan module, so as to increase a suction force of the fan module. If the detected value is smaller than the threshold, the control unit turns off the fan module.

8 Claims, 4 Drawing Sheets





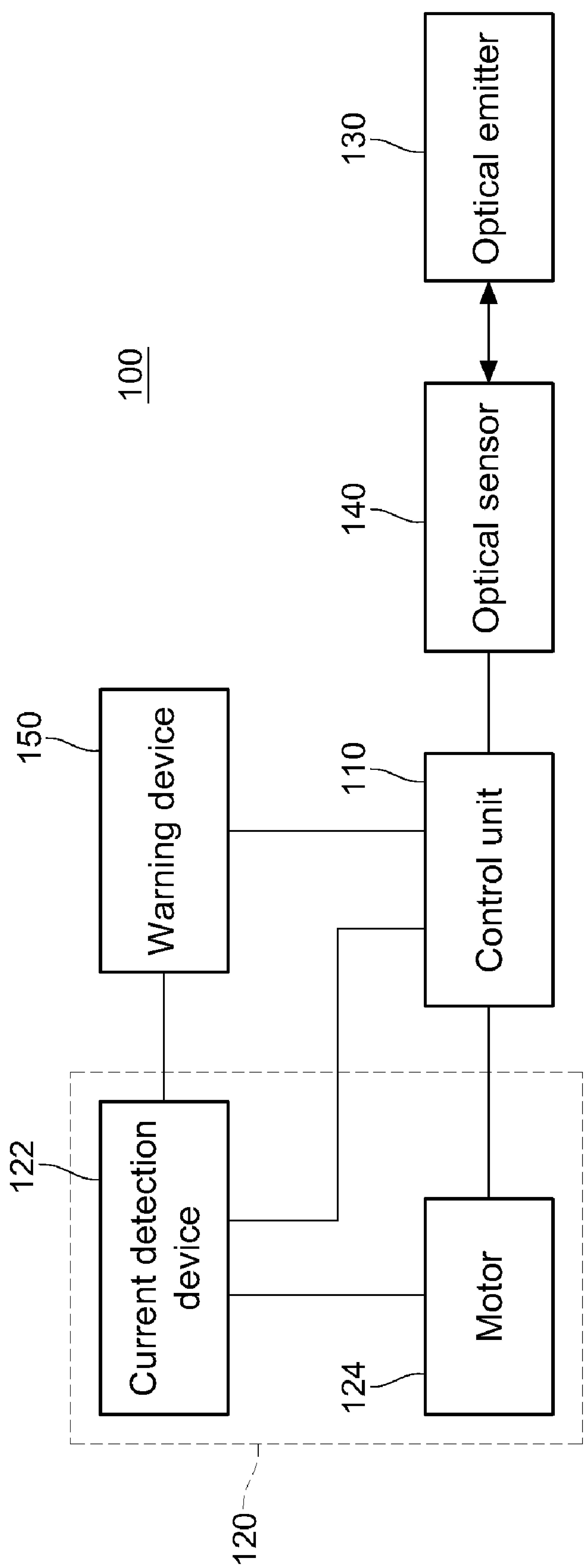

100
130
Optical emitter
140
Optical sensor
150
Warning device
110
Control unit
122
Current detection device
124
Motor
120

FIG.1A

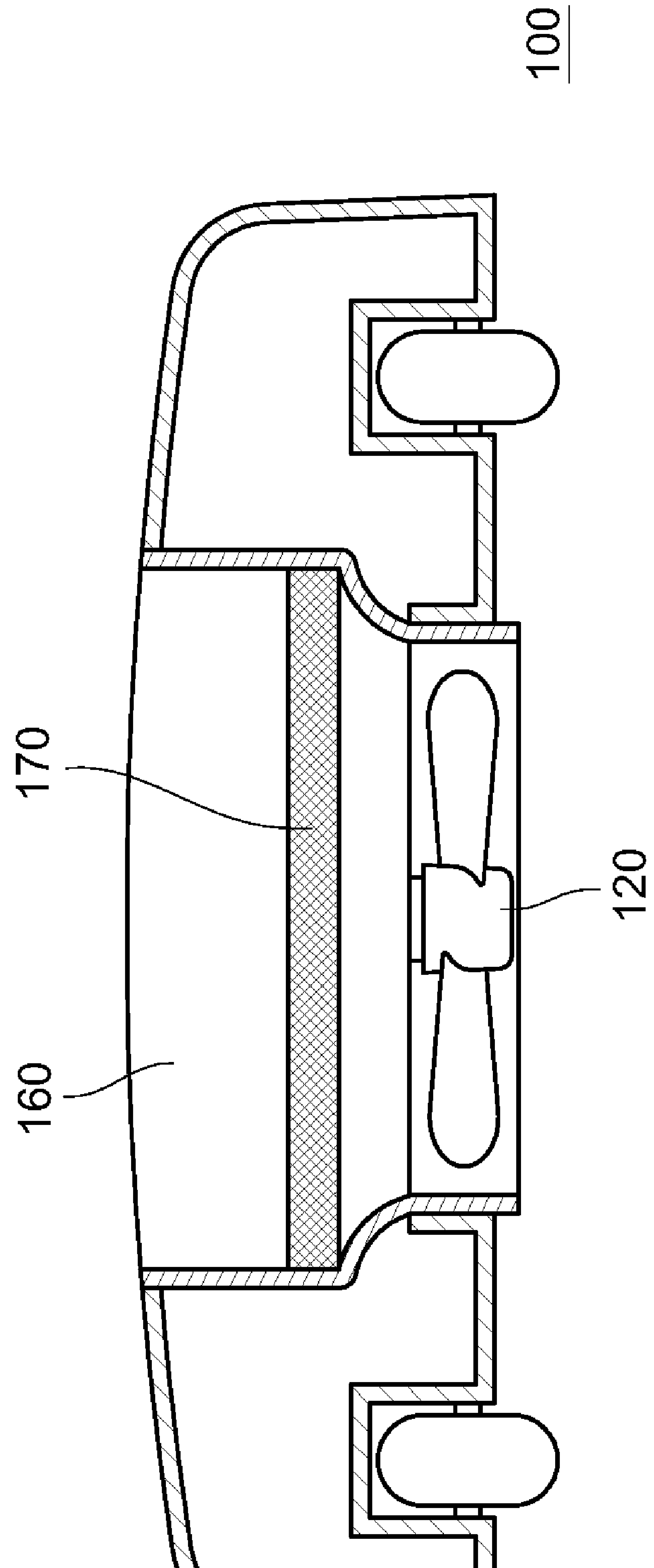


FIG.1B

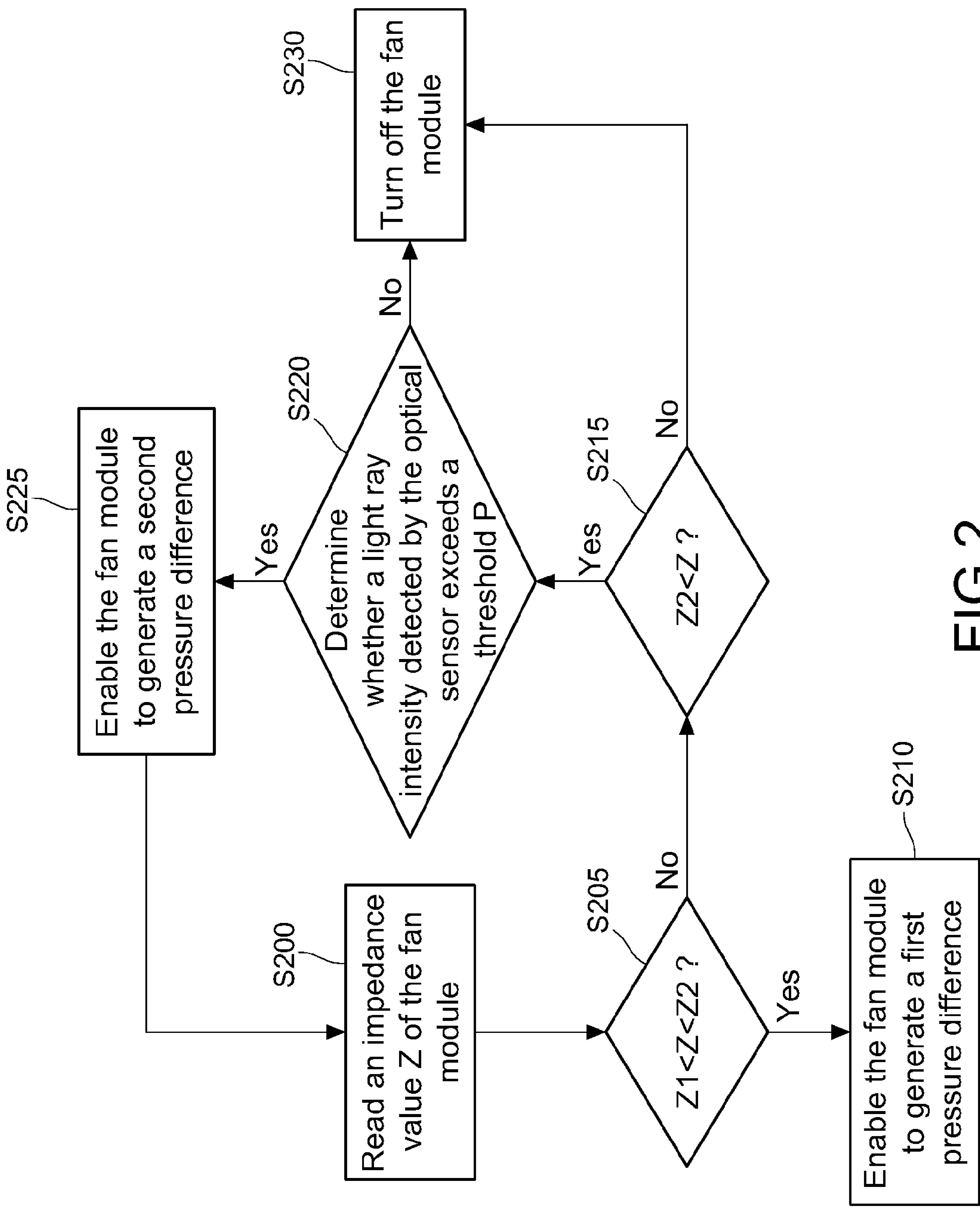

S200
Read an impedance value Z of the fan module
S205
Z1<Z<Z2 ?
Yes
No
S210
Enable the fan module to generate a first pressure difference
S215
Z2<Z ?
Yes
No
S220
Determine whether a light ray intensity detected by the optical sensor exceeds a threshold P
Yes
No
S225
Enable the fan module to generate a second pressure difference
S230
Turn off the fan module

FIG.2

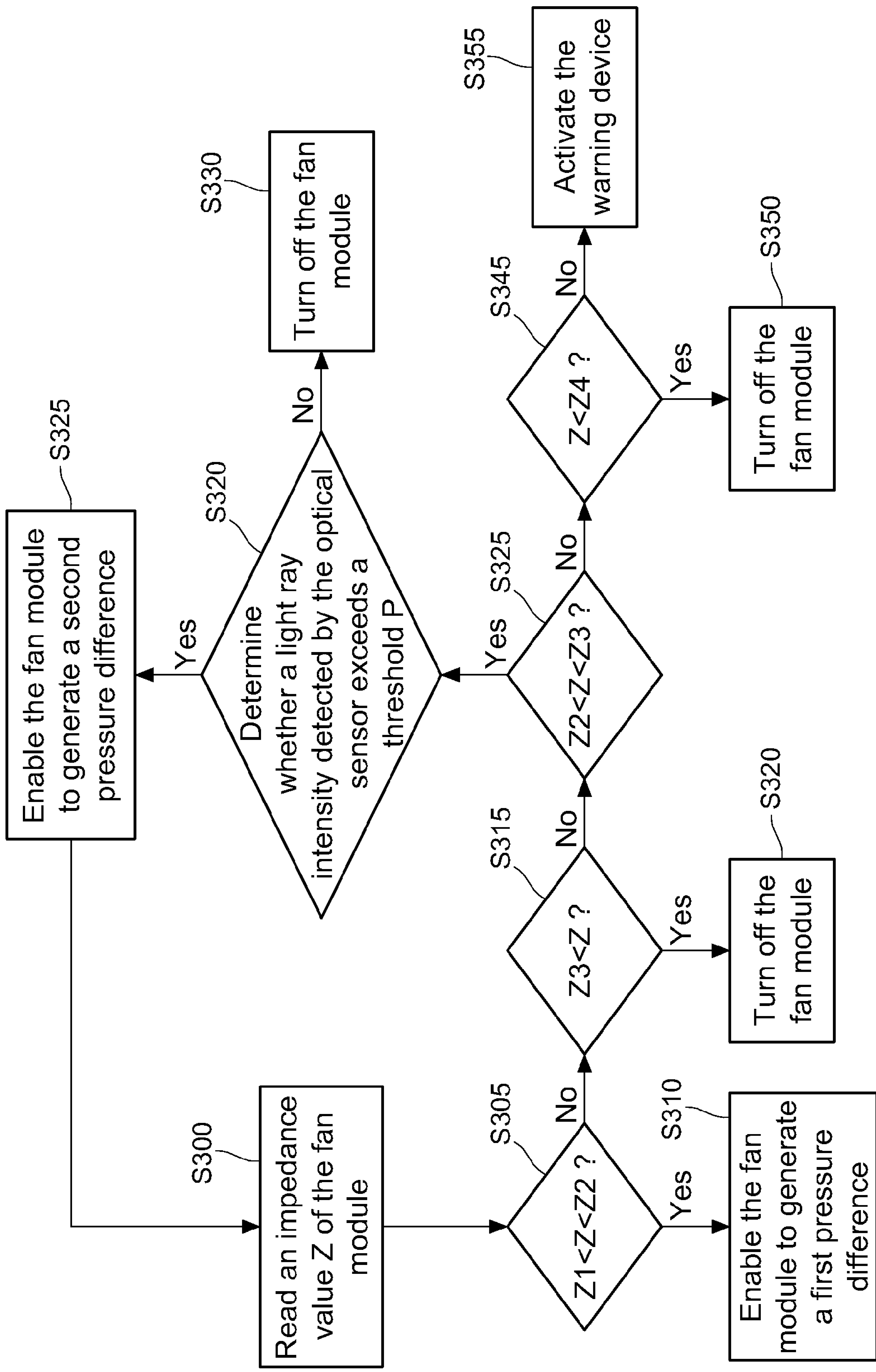

S300
Read an impedance value Z of the fan module
S305
Z1<Z<Z2 ?
Yes
No
S310
Enable the fan module to generate a first pressure difference
S315
Z3<Z ?
Yes
No
S320
Turn off the fan module
S325
Z2<Z<Z3 ?
Yes
No
S320
Determine whether a light ray intensity detected by the optical sensor exceeds a threshold P
Yes
No
S325
Enable the fan module to generate a second pressure difference
S330
Turn off the fan module
S345
Z<Z4 ?
Yes
No
S350
Turn off the fan module
S355
Activate the warning device

FIG.3

METHOD FOR CONTROLLING CLEANING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This non-provisional application claims priority under 35 U.S.C. §119(a) on Patent Application No(s). 098138838 filed in Taiwan, R.O.C. on Nov. 16, 2009, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method for controlling a cleaning device, and more particularly to a method for controlling a vacuum cleaner.

2. Related Art

Particle (dust) detecting technologies have been applied to particle amount detection and environment control of conventional vacuum cleaners, air cleaners, and self-propelled vacuum cleaners, so as to clean up the particles (dust) more effectively. Therefore, as long as the amount of particles (dust) can be detected in a simple but effective manner, such a technology may be used to enhance the service efficiency of the conventional vacuum cleaner, the air cleaner, and the self-propelled vacuum cleaner, thereby achieving the effect of energy saving and carbon reduction.

The existing particle detecting technologies may be roughly divided into the following three types.

(1) Optical detecting type: in the particle detecting technology of this type, the content of particles (dust) in the air is detected by using a pair of optical emitting and receiving devices. When the content of particles (dust) in the air rises, the light flux detected by the receiving device is lowered with the increase of the content of particles (dust). Therefore, such a technology can determine the content of particles (dust) in the air through the light flux detected by the receiving device.

(2) Pressure difference detecting type: in the particle detecting technology of this type, the content of particles (dust) in the conventional vacuum cleaner, the air cleaner, and the self-propelled vacuum cleaner is determined through the pressure difference between the air inlet and the air outlet of the conventional vacuum cleaner, the air cleaner, or the self-propelled vacuum cleaner.

(3) Piezoelectric pressure sensing type: in the particle detecting technology of this type, a pressure sensing element fabricated by using lead zirconate titanate (PZT) is placed on a wall of the air inlet. Therefore, when the particles (dust) in the air are sucked into the air inlet of the conventional vacuum cleaner, the air cleaner, or the self-propelled vacuum cleaner, such a technology can determine the amount of garbage in the air inlet through the force of impacting the pressure sensing element by the particles (dust).

Although various particle detecting technologies are proposed in the prior art, the conventional vacuum cleaner, the air cleaner, or the self-propelled vacuum cleaner still cannot automatically recognize the states that a mechanical failure occurs, the filter screen is broken, the dust collection box is full, the amount of dust is increased, and the like.

SUMMARY OF THE INVENTION

In order to solve the above problem, the present invention is a method for controlling a cleaning device, so as to automatically recognize the states that the dust collection box is full, the amount of dust is increased, the cleaning device is in a normal state, and the like.

Therefore, in an embodiment, the present invention provides a method for controlling a cleaning device, which comprises the following steps. A cleaning device, comprising a control unit, a fan module, an optical emitter, and an optical sensor, is provided. The fan module and the optical sensor are respectively electrically connected to the control unit. The optical emitter and the optical sensor are located in an air inlet of the fan module, and the optical sensor receives a light ray emitted by the optical emitter. The control unit is preset with a first impedance value (Z1), a second impedance value (Z2), and a threshold, where $0<Z1<Z2$. Then, the control unit reads an impedance value (Z) of the fan module, and compares the impedance value with the first impedance value and the second impedance value. If $Z1<Z<Z2$, the control unit drives the fan module to generate a first pressure difference. If $Z2<Z$, the control unit reads an intensity of the received light ray detected by the optical sensor. If the light ray intensity exceeds the threshold, the control unit drives the fan module to generate a second pressure difference, and the second pressure difference is greater than the first pressure difference. If the light ray intensity is smaller than the threshold, the control unit turns off the fan module.

In other embodiments of the present invention, if $Z<Z1$, the control unit turns off the fan module.

Moreover, in another embodiment, the present invention further provides a method for controlling a cleaning device, which comprises the following steps. A cleaning device, comprising a control unit, a fan module, an optical emitter, and an optical sensor, is provided. The fan module and the optical sensor are respectively electrically connected to the control unit. The optical emitter and the optical sensor are located in an air inlet of the fan module. The optical sensor receives a light ray emitted by the optical emitter, and detects an intensity of the received light ray. The control unit is preset with a first impedance value (Z1), a second impedance value (Z2), a third impedance value (Z3), and a threshold, where $0<Z1<Z2<Z3$. Then, the control unit reads an impedance value (Z) of the fan module, and compares the impedance value with the first impedance value, the second impedance value, and the third impedance value. If $Z1<Z<Z2$, the control unit drives the fan module to generate a first pressure difference. If $Z2<Z<Z3$, the control unit reads the intensity of the received light ray detected by the optical sensor. If the light ray intensity exceeds the threshold, the control unit drives the fan module to generate a second pressure difference, and the second pressure difference is greater than the first pressure difference. If the light ray intensity is smaller than the threshold, the control unit turns off the fan module. If $Z3<Z$, the control unit turns off the fan module.

In other embodiments of the present invention, the control unit is preset with a fourth impedance value (Z4), where $0<Z4<Z1<Z2<Z3$, and the method further comprises: turning off the fan module by the control unit, if $Z<Z4$, and preferably emitting a warning signal by the control unit, if $Z4<Z<Z1$, in which the warning signal is, for example, a sound or a light ray.

In other embodiments of the present invention, the fan module comprises a current detection device, a motor, and a fan. The fan is connected to the motor, and the current detection device is electrically connected to the motor and the control unit. The step of reading the impedance value (Z) of the fan module by the control unit further comprises: detecting a current value of the motor by the current detection device and transmitting the current value to the control unit;

and then, converting the current value to the impedance value of the motor by the control unit.

In view of the above, in the aforementioned embodiments, the control unit determines a change of the impedance value of the fan module, and automatically increases a suction force of the fan module or turns off the fan module according to the change of the impedance value of the fan module, thereby greatly improving the use convenience. Moreover, the control unit detects an output signal of the optical sensor, such that the control unit is enabled to turn off the fan module in a state that the dust collection box is full, so as to prevent the fan module from continuously operating in this state to result in energy waste.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given herein below for illustration only, and thus are not limitative of the present invention, and wherein:

FIG. **1**A is a schematic circuit diagram of a cleaning device according to an embodiment of the present invention;

FIG. **1**B is a schematic structural view of a dust collection box, a fan module, and a filter screen of a cleaning device according to an embodiment of the present invention;

FIG. **2** shows a method for controlling a cleaning device according to an embodiment of the present invention; and

FIG. **3** shows a method for controlling a cleaning device according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1**A is a schematic circuit diagram of a cleaning device according to an embodiment of the present invention. Referring to FIG. **1**A, for ease of illustration, the cleaning device **100** of this embodiment is, for example, a vacuum cleaner. In other embodiments of the present invention, the cleaning device **100** and a method for controlling the cleaning device **100** described in the following may also be applied to an air cleaner. The cleaning device **100** comprises a control unit **110**, a fan module **120**, an optical emitter **130**, and an optical sensor **140**. In this embodiment, the control unit **110** is, for example, a logic circuit. However, in another embodiment of the present invention, the control unit **110** comprises, for example, a microprocessor and a memory. A program is stored in the memory. The microprocessor is electrically connected to the memory, such that the microprocessor executes a series of steps according to the program. In still another embodiment of the present invention, the control unit **110** is, for example, an application specific integrated circuit (ASIC). Based on the above, the control unit **110** may be programmed to execute a series of steps in the method for controlling the cleaning device **100**. A first impedance value Z1 and a second impedance value Z2 are preset in the control unit **110**, where 0<Z1<Z2. In addition, a threshold P is preset in the control unit **110**.

The fan module **120** is electrically connected to the control unit **110**, and the control unit **110** is enabled to read an impedance value of the fan module **120**. More particularly, the fan module **120** comprises a current detection device **122**, a motor **124**, and a fan (not shown). The fan is fixed on the motor **124**, such that when the motor **124** is in an operating state, the fan module **120** generates a pressure difference between an air inlet and an air outlet, so as to suck garbage into a dust collection box of the cleaning device **100**. The current detection device **122** is respectively electrically connected to the motor **124** and the control unit **110**, and the current detection device **122** is used for detecting a current value of the motor **124**. It should be noted that, although the current detection device **122** and the motor **124** of the fan module **120** are two independent elements in this embodiment, the configuration of the fan module **120** is not limited herein. In other embodiments of the present invention, when the motor **124** is a brushless electric motor, the current detection device **122** may also be integrated in the motor **124**.

The optical emitter **130** and the optical sensor **140** are located on a wall of the air inlet of the fan module **120**. In this embodiment, the optical emitter **130** is an infrared emitter. The optical emitter **130** is used for emitting a light ray (that is, an infrared ray). The optical sensor **140** is used for receiving the light ray emitted by the optical emitter **130**, and outputting a signal according to an intensity of the received light ray. The optical sensor **140** is electrically connected to the control unit **110**, such that the control unit **110** is enabled to determine the intensity of the light ray received by the optical sensor **140** according to the signal output by the optical sensor **140**.

FIG. **1**B is a schematic structural view of the dust collection box, the fan module, and a filter screen of the cleaning device **100**. Referring to FIG. **1**B, since the cleaning device **100** of this embodiment is, for example, the vacuum cleaner, the cleaning device **100** further comprises a dust collection box **160** and a filter screen **170** located between the located dust collection box **160** and the fan module **120**.

Based on the above, in this embodiment, the control unit **110** executes the following steps. FIG. **2** shows the method for controlling the cleaning device according to an embodiment of the present invention. Referring to FIGS. **1**A and **2**, firstly, as shown in Step S**200**, the control unit **110** reads an impedance value Z of the fan module **120**. For example, in a method of reading the fan module **120**, the current detection device **122** first detects a current value of the motor **124**; and then, the control unit **110** reads the current value detected by the current detection device **122**, and converts the current value to the impedance value Z of the motor.

Next, as shown in Step S**205**, the control unit **110** respectively compares the read impedance value Z of the fan module **120** with the first impedance value Z1 and the second impedance value Z2, so as to determine whether the impedance value Z is between the first impedance value Z1 and the second impedance value Z2, that is, Z1<Z<Z2. If yes, it is determined that the cleaning device **100** is in the normal state, and the control unit **110** executes Step S**210**. In Step S**210**, the control unit **110** drives the fan module **120** to generate a first pressure difference. In other words, the control unit **110** drives the fan module **120** so as to enable the fan of the fan module **120** to rotate at a normal speed. It should be noted that, since the cleaning device **100** of this embodiment is, for example, the vacuum cleaner, the first pressure difference is used for sucking garbage or dust from outside the cleaning device **100** into the dust collection box of the cleaning device **100**.

If the impedance value Z is not between the first impedance value Z1 and the second impedance value Z2, the control unit **110** executes Step S**215**. In Step S**215**, the control unit **110** determines whether the impedance value Z of the fan module **120** is greater than the second impedance value Z2, and if yes, the control unit **110** executes Step S**220**.

In Step S**220**, the control unit **110** reads an intensity of a light ray detected by the optical sensor **140**, and determines whether the intensity of the light ray detected by the optical sensor **140** exceeds a threshold P preset in the control unit **110**. In this embodiment, the optical emitter **130** and the optical sensor **140** are located on the wall of the air inlet of the fan module **120**, and the optical sensor **140** is electrically connected to the control unit **110**, such that the intensity of the light ray received by the optical sensor **140** is in inverse proportion to the amount of garbage between the emitter **130** and the optical sensor **140**. After the optical sensor **140** receives the light ray, the optical sensor **140** converts the intensity of the received light ray to an output signal, and transmits the output signal to the control unit **110**. Therefore, the control unit **110** is enabled to determine whether the intensity of the light ray detected by the optical sensor **140** is greater than the threshold P preset in the control unit **110** according to the output signal.

In Step S**220**, if the intensity of the light ray detected by the optical sensor **140** is greater than the threshold P preset in the control unit **110**, the control unit **110** determines that the dust collection box of the cleaning device **100** is not full and the amount of garbage sucked into the cleaning device **100** in a unit time is increased. After that, the control unit **110** executes Step S**225**.

In Step S**225**, the control unit **110** controls the fan module **120** and raises the pressure difference generated by the fan module **120** from the first pressure difference to a second pressure difference, in which the second pressure difference is greater than the first pressure difference. In other words, the control unit **110** drives the fan module **120** so as to enable the fan of the fan module **120** to rotate at a speed higher than the normal rotation speed. Based on the above steps, the cleaning device **100** automatically increases the suction force in response to the increase of the amount of garbage. Next, the control unit **110** re-executes Step S**200** to detect the impedance value of the fan module **120** again.

Referring to Step S**220**, if the intensity of the light ray detected by the optical sensor **140** is smaller than the threshold P preset in the control unit **110**, the control unit **110** determines that the dust collection box of the cleaning device **100** is full. Afterward, the control unit **110** executes Step S**230**.

In Step **230**, the dust collection box is full, and the control unit **110** turns off the fan module **120**. Through Step S**225**, the cleaning device **100** automatically prevents the fan module **120** from continuously operating in the state that the dust collection box is full to result in energy waste.

Based on the above steps, the method for controlling the cleaning device **100** of this embodiment can automatically determine whether the cleaning device is in a normal state, or in a state that the dust collection box is full or the amount of garbage is increased, or the like, so as to adopt corresponding response measures.

In addition to the recognition of the above states, referring to Step S**215**, if the impedance value Z of the fan module **120** is not greater than the second impedance value Z2, the impedance value Z of the fan module **120** is smaller than the first impedance value Z1. In this case, the control unit **110** determines that the filter screen is broken, and the control unit **110** executes Step S**235**, that is, to turn off the fan module **120**.

In addition to the method for controlling the cleaning device, according to another embodiment of the present invention, the control unit **110** is preset with four impedance values, that is, a first impedance value Z1, a second impedance value Z2, a third impedance value Z3, and a fourth impedance value Z4, where $0<Z4<Z1<Z2<Z3$. Moreover, the control unit **110** is also preset with a threshold P.

Based on the above, in this embodiment, the control unit **110** executes the following steps. FIG. **3** shows the method for controlling the cleaning device according to another embodiment of the present invention. Referring to FIGS. **1**A and **3**, firstly, as shown in Step S**300**, the control unit **110** reads an impedance value Z of the fan module **120**. For example, in a method of reading the fan module **120**, the current detection device **122** first detects a current value of the motor **124**; and then, the control unit **110** reads the current value detected by the current detection device **122**, and converts the current value to the impedance value Z of the motor.

Next, as shown in Step S**305**, the control unit **110** respectively compares the read impedance value Z of the fan module **120** with the first impedance value Z1 and the second impedance value Z2, so as to determine whether the impedance value Z is between the first impedance value Z1 and the second impedance value Z2, that is, $Z1<Z<Z2$. If yes, it is determined that the cleaning device **100** is in the normal state, and the control unit **110** executes Step S**310**. In Step S**310**, the control unit **110** drives the fan module **120** to generate a first pressure difference. It should be noted that, since the cleaning device **100** of this embodiment is, for example, the vacuum cleaner, the first pressure difference is used for sucking garbage or dust from outside the cleaning device **100** into the dust collection box of the cleaning device **100**.

Referring to Step S**305**, if the impedance value Z is not between the first impedance value Z1 and the second impedance value Z2, the control unit **110** executes Step **315**. In Step S**315**, the control unit **110** determines whether the impedance value Z of the fan module **120** is greater than the third impedance value Z3. If yes, the control unit **110** determines that a mechanical failure occurs to the fan module **120**, and executes Step S**320**. In Step S**320**, the control unit **110** turns off the fan module **120**.

Referring to Step S**315**, if the control unit **110** determines that the impedance value Z of the fan module **120** is not greater than the third impedance value Z3, the control unit **110** executes Step S**325**. In Step S**325**, the control unit **110** determines whether the impedance value Z of the fan module **120** is between the second impedance value Z2 and the third impedance value Z3, that is, $Z2<Z<Z3$. If yes, the control unit **110** executes Step S**320**.

In Step S**320**, the control unit **110** reads an intensity of a light ray detected by the optical sensor **140**, and determines whether the intensity of the light ray detected by the optical sensor **140** exceeds a threshold P preset in the control unit **110**. In this embodiment, the optical emitter **130** and the optical sensor **140** are located on the wall of the air inlet of the fan module **120**, and the optical sensor **140** is electrically connected to the control unit **110**, such that the intensity of the light ray received by the optical sensor **140** is in inverse proportion to the amount of garbage between the emitter **130** and the optical sensor **140**. After the optical sensor **140** receives the light ray, the optical sensor **140** converts the intensity of the received light ray to an output signal, and transmits the output signal to the control unit **110**. Therefore, the control unit **110** is enabled to determine whether the intensity of the light ray detected by the optical sensor **140** is greater than the threshold P preset in the control unit **110** according to the output signal.

In Step S**320**, if the intensity of the light ray detected by the optical sensor **140** is greater than the threshold P preset in the control unit **110**, the control unit **110** determines that the dust collection box of the cleaning device **100** is not full and the amount of garbage sucked into the cleaning device **100** in a unit time is increased. After that, the control unit **110** executes Step S**325**.

In Step S**325**, the dust collection box is not full and the amount of garbage is increased, such that the control unit **110** controls the fan module **120** and raises the pressure difference generated by the fan module **120** from the first pressure difference to a second pressure difference, in which the second pressure difference is greater than the first pressure difference. Based on the above steps, the cleaning device **100** automatically increases the suction force in response to the increase of the amount of garbage. Next, the control unit **110** re-executes Step S**300** to detect the impedance value of the fan module **120** again.

Referring to Step S**320**, if the intensity of the light ray detected by the optical sensor **140** is smaller than the threshold P preset in the control unit **110**, the control unit **110** determines that the dust collection box of the cleaning device **100** is full. Afterward, the control unit **110** executes Step S**330**.

In Step S**330**, the dust collection box is full, and the control unit **110** turns off the fan module **120**. Through Step S**330**, the cleaning device **100** automatically prevents the fan module **120** from continuously operating in the state that the dust collection box is full to result in energy waste.

In addition to the recognition of the above states, referring to Step S**325**, if the impedance value Z of the fan module **120** is not between the second impedance value Z2 and the third impedance value Z3, the control unit **110** determines whether the impedance value Z of the fan module **120** is smaller than the fourth impedance value Z4 (Step S**345**). If yes, the control unit **110** determines that the filter screen is not installed in the cleaning device **100**, and executes Step S**350**. In Step S**350**, the control unit **110** turns off the fan module **120**.

Referring to Step S**345**, if the impedance value Z of the fan module **120** is not smaller than the fourth impedance value Z4, the impedance value Z of the fan module **120** is between the first impedance value Z1 and the fourth impedance value Z4. In this case, the control unit **110** determines that the filter screen is broken, and the control unit **110** executes Step S**355**. In Step S**355**, the control unit **110** turns off the fan module **120**. Preferably, in this embodiment, as shown in FIG. **1**A, the cleaning device **100** further comprises a warning device **150**, and the warning device **150** is electrically connected to the control unit **110**. The warning device **150** is, for example, a buzzer or an indicator. Based on the design of the warning device **150**, when the impedance value Z of the fan module **120** is not smaller than the second impedance value Z2, in addition to turning off the fan module **120**, the control unit **110** also activates the warning device **150**, so as to remind the user to replace the filter screen by making a sound or emitting a light.

In view of the above, in the aforementioned embodiments, the control unit determines a change of the impedance value of the fan module, and automatically increases a suction force of the fan module or turns off the fan module according to the change of the impedance value of the fan module, thereby greatly improving the use convenience. Moreover, the control unit detects an output signal of the optical sensor, such that the control unit is enabled to turn off the fan module in a state that the dust collection box is full, so as to prevent the fan module from continuously operating in this state to result in energy waste.

What is claimed is:

1. A method for controlling a cleaning device, comprising:

providing a cleaning device which comprises a control unit, a fan module, an optical emitter and an optical sensor, wherein the fan module and the optical sensor are respectively electrically connected to the control unit, the optical emitter and the optical sensor are located in an air inlet of the fan module, the optical sensor receives a light ray emitted by the optical emitter and detects an intensity of the received light ray, and the control unit is preset with a first impedance value (Z1), a second impedance value (Z2) and a threshold, where $0 < Z1 < Z2$; and

reading an impedance value (Z) of the fan module by the control unit and comparing the impedance value with the first impedance value and the second impedance value, wherein

if $Z1 < Z < Z2$, the control unit drives the fan module to generate a first pressure difference; and

if $Z2 < Z$, the control unit reads the intensity of the received light ray detected by the optical sensor, where the control unit drives the fan module to generate a second pressure difference greater than the first pressure difference if the light ray intensity exceeds the threshold, and the control unit turns off the fan module if the light ray intensity is smaller than the threshold.

2. The method for controlling the cleaning device according to claim **1**, wherein if $Z < Z1$, the control unit turns off the fan module.

3. The method for controlling the cleaning device according to claim **1**, wherein the fan module comprises a current detection device, a motor and a fan, the fan is connected to the motor, the current detection device is electrically connected to the motor and the control unit, and the step of reading the impedance value (Z) of the fan module by the control unit further comprises:

detecting a current value of the motor by the current detection device and transmitting the current value to the control unit; and

converting the current value to the impedance value of the motor by the control unit.

4. A method for controlling a cleaning device, comprising:

providing a cleaning device which comprises a control unit, a fan module, an optical emitter and an optical sensor, wherein the fan module and the optical sensor are respectively electrically connected to the control unit, the optical emitter and the optical sensor are located in an air inlet of the fan module, the optical sensor receives a light ray emitted by the optical emitter and detects an intensity of the received light ray, and the control unit is preset with a first impedance value (Z1), a second impedance value (Z2), a third impedance value (Z3) and a threshold, where $0 < Z1 < Z2 < Z3$; and

reading an impedance value (Z) of the fan module by the control unit and comparing the impedance value with the first impedance value, the second impedance value and the third impedance value, wherein if $Z1 < Z < Z2$, the control unit drives the fan module to generate a first pressure difference;

if $Z2 < Z < Z3$, the control unit reads the intensity of the received light ray detected by the optical sensor, where the control unit drives the fan module to generate a second pressure difference greater than the first pressure difference if the light ray intensity exceeds the threshold, and the control unit turns off the fan module if the light ray intensity is smaller than the threshold; and

if $Z3 < Z$, the control unit turns off the fan module.

5. The method for controlling the cleaning device according to claim **4**, wherein the control unit is preset with a fourth impedance value (Z4), where $0 < Z4 < Z1 < Z2 < Z3$, and the method further comprises: turning off the fan module by the control unit if $Z < Z4$.

6. The method for controlling the cleaning device according to claim **5**, further comprising:

emitting a warning signal by the control unit if $Z4 < Z < Z1$.

7. The method for controlling the cleaning device according to claim **6**, wherein the warning signal is a sound or another light ray.

8. The method for controlling the cleaning device according to claim **4**, wherein the fan module comprises a current detection device, a motor and a fan, the fan is connected to the motor, the current detection device is electrically connected to the motor and the control unit, and the step of reading the impedance value (Z) of the fan module by the control unit further comprises:

detecting a current value of the motor by the current detection device and transmitting the current value to the control unit; and

converting the current value to the impedance value of the motor by the control unit.

* * * * *